

SF File Number

1.1



United States
Environmental Protection
Agency

Environmental Monitoring
Systems Laboratory
P.O. Box 15027
Las Vegas, NV 89114

TS-AMD-83056e
November 1984



1244448 - R8 SDMS

Research and Development

AERIAL PHOTOGRAPHIC ANALYSIS OF WASTE STUDY SITES

Montana

EPA Region 8



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November 1984

AERIAL PHOTOGRAPHIC ANALYSIS
WASTE STUDY SITES

Montana

by

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ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
LAS VEGAS, NEVADA 89114

NOTICE

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ABSTRACT

This report presents single-date and intensive analyses of ten hazardous waste sites in Montana. Single-date analyses were performed for the Exxon Corporation Refinery, Montana Sulfur, Transbas, Burlington Northern Tie Treating, Conoco Landfarm, Anaconda Aluminum, Union Tank Car, and Black Eagle Refinery sites. Color aerial photographs acquired on August 27 and 29, 1983, served as the data source for these analyses. Intensive analyses were performed for the Great Falls Landfill and Billings Landfill sites. The analysis for these sites covered a 34-year period from 1950-1983 and a 27-year period from 1957-1983, respectively.

Solid and liquid wastes were observed at all of the sites; however, no waste disposal was observed at the Union Tank Car site. All sites were active at the time of the 1983 photographs except the Union Tank Car site.

The U.S. Environmental Protection Agency's Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, prepared this report for the Agency's Environmental Services Division in Region 8 and Office of Emergency and Remedial Response in Washington, D.C. The analyses were performed to assess site status.

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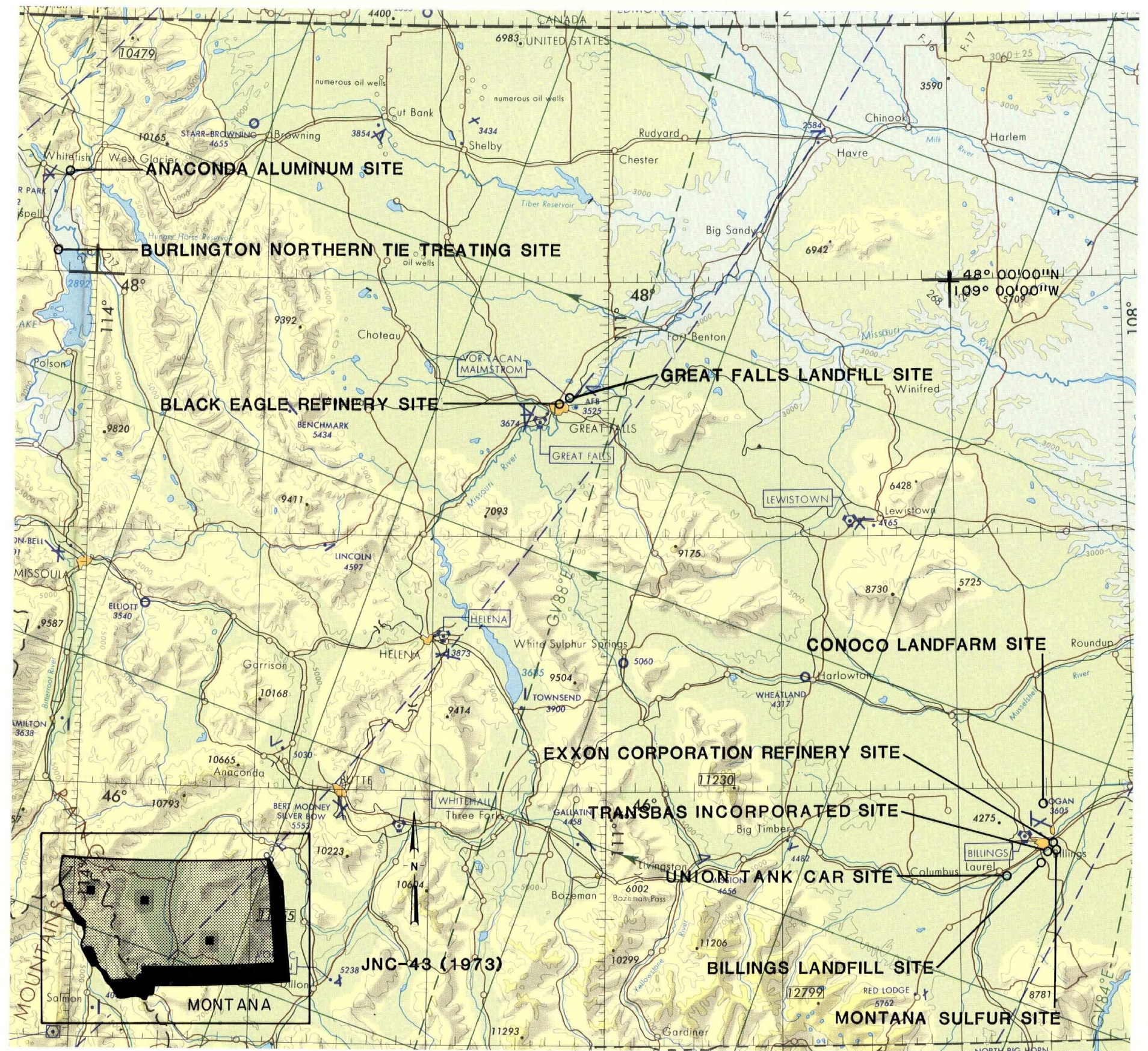


Figure 1. Regional site locations. Scale 1:2,000,000.

INTRODUCTION

This report presents intensive and single-date analyses of ten hazardous waste study sites in Billings, Somers, Hickson Ranch, Columbia Falls, Laurel, and Great Falls, Montana, (figure 1). Color aerial photographs acquired on August 27 and 29, 1983, were the source for the single-date analyses of the Exxon Corporation Oil Refinery, the Conoco Landfarm, the Montana Sulfur, the Transbas, Inc., the Anaconda Aluminum, the Burlington Northern Tie Treating, the Black Eagle Refinery and the Union Tank Car sites. Intensive analyses covered a 34-year period (1950-1983) for the Great Falls Landfill and a 27-year period (1957-1983) for the Billings Landfill.

Surface drainage and ground water recharge and discharge areas were of interest at all the sites. Past landfill areas were a special concern at the Billings and Great Falls Landfills.

Spillage of hazardous materials was a source of concern at the Union Tank Car and the Burlington Northern Tie Treating sites. At the Black Eagle and Exxon Corporation refineries and the Transbas, Inc., Conoco Landfarm, Montana Sulfur, and Anaconda Aluminum sites, surface impoundments and land treatment areas were a primary focus of the analysis.

This report was prepared by the U.S. Environmental Protection Agency's Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, at the request of the Agency's Environmental Services Division of Region 8 and the Office of Emergency and Remedial Response in Washington, D.C.

METHODOLOGY

Stereoscopic pairs of historical and current aerial photographs are used to perform the intensive and single-date analyses. Stereo viewing enhances the interpretation because it allows the analyst to observe the vertical as well as horizontal spatial relationships of natural and cultural features. Stereoscopy is also an aid in distinguishing between the various shapes, tones, textures, and colors that can be found within the study area.

Evidence of waste burial is a prime consideration when conducting a hazardous waste analysis. Burial and dumping of hazardous materials could result in leachate or seepage which often threatens existing surface or groundwater sources. Pools of unexplained liquid are routinely noted because they can indicate seepage from buried wastes and may enter drainages that allow contaminants to move off the site. The presence or absence of spills, spill stains, and vegetation damage within a site is an excellent indicator of how well hazardous materials are being handled at that site. Trees and other forms of vegetation that exhibit a marked color difference from surrounding members of the same species are labeled "dead" or "stressed" based upon the degree of noticeable variation. Vegetation is so labeled only after a careful consideration of the season in which the photograph was acquired.

Drainage analysis is conducted in order to determine the direction a spill or surface runoff would follow. Direction of drainage is determined from the analysis of the photographs and from the U.S. Geological Survey topographic maps. Archival and current aerial photographs of the 10 Montana waste study sites were acquired from the sources listed in the following table:

TABLE 1. PHOTOGRAPHIC SPECIFICATIONS

Figure	Site Name and Geographic Coordinates	Site Location	Date of Acquisition	Original Scale	Film Type	Photo Source*
3-4	Exxon Corp. Oil Refinery (45°48.8'N 108°26.1"W)	Billings, MT	8/27/83	1:8,000	Color	EMSL-LV
	Montana Sulfur (45°48.8'N 108°25.6"W)	Billings, MT	8/27/83	1:8,000	Color	EMSL-LV
5	Transbas, Inc. (45°48.4'N 108°26.7"W)	Billings, MT	8/27/83	1:8,000	Color	EMSL-LV
7	Burlington Northern Tie- Treating (48°04.9'N 114°13.2"W)	Somers, MT	8/27/83	1:8,000	Color	EMSL-LV
9	Conoco Landfarm (45°55.7'N 108°31.9"W)	Hickson Ranch, MT	8/27/83	1:6,000	Color	EMSL-LV
11	Anaconda Aluminum (48°23.6'N 114°08.2"W)	Columbia Falls, MT	8/29/83	1:8,000	Color	EMSL-LV
13	Union Tank Car (45°40.3'N 108°43.1"W)	Laurel, MT	8/27/83	1:4,000	Color	EMSL-LV
15	Black Eagle Refinery (47°31.2'N 111°17.7"W)	Great Falls, MT	8/29/83	1:8,000	Color	EMSL-LV
16	Great Falls Landfill (47°32.2'N 111°14.6"W)	Great Falls, MT	8/27/50	1:20,000	B&W	ASCS
17			9/19/64	1:17,400	B&W	EROS
18			7/15/66	1:20,000	B&W	ASCS
19			10/15/77	1:40,000	B&W	ASCS
20			8/29/83	1:8,000	Color	EMSL-LV
	Billings Landfill					
22	(45°43.0'N 108°33.0"W)	Billings, MT	7/16/57	1:20,000	B&W	ASCS
23			7/22/66	1:20,000	B&W	ASCS
24			7/24/72	1:40,000	B&W	ASCS
25			9/14/79	1:40,000	B&W	ASCS
26			8/27/83	1:8,000	Color	EMSL-LV

***Photo source identification:**

ASCS - U.S. Department of Agriculture, Agricultural Stabilization and
Conservation Service

EROS - U.S. Department of the Interior, U.S. Geological Survey, Earth Resources
Observation Systems Data Center.

EMSL-LV - U.S. Environmental Protection Agency, Environmental Monitoring
Systems Laboratory-Las Vegas, Nevada.

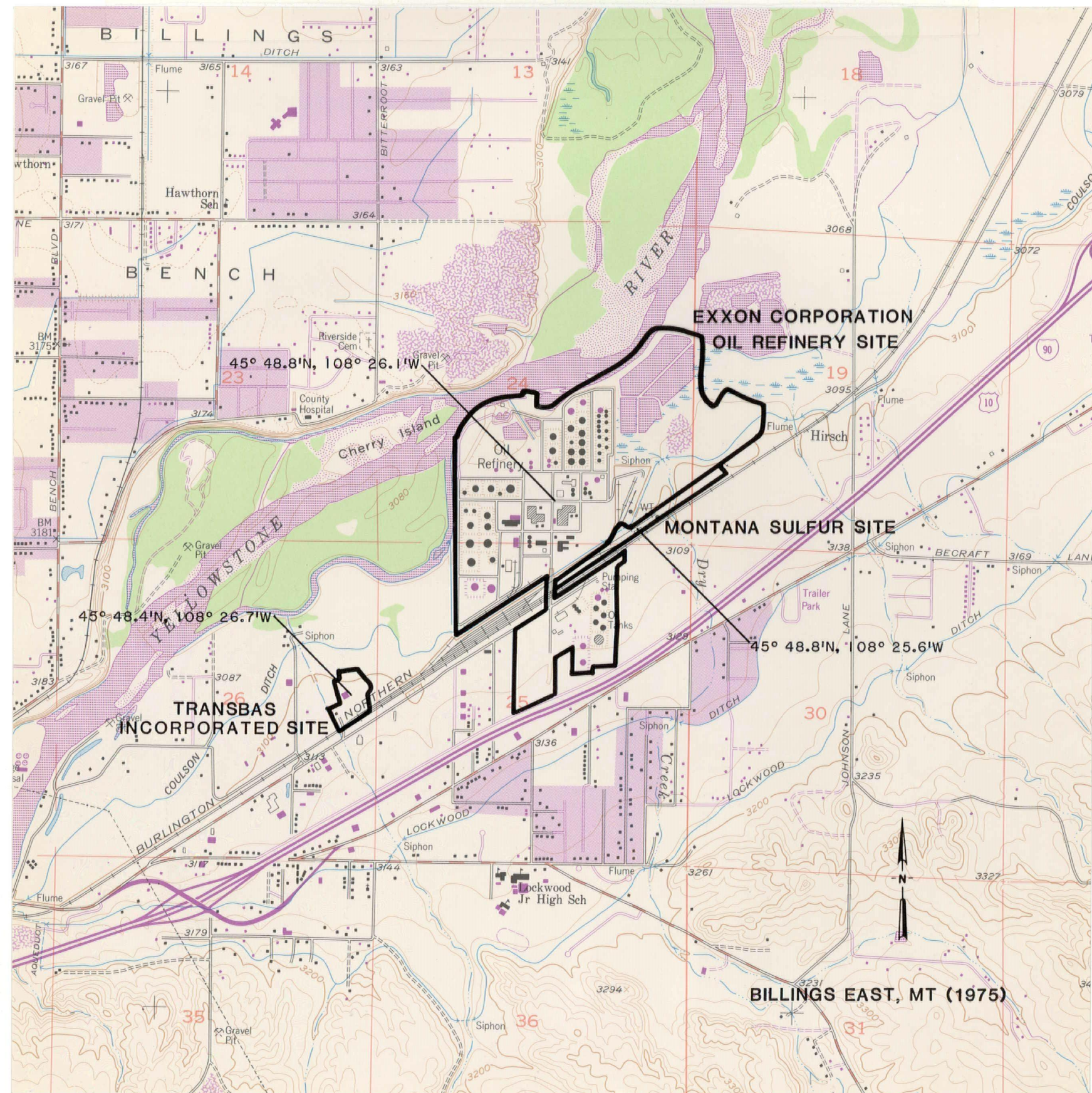


Figure 2. Local site locations, Billings, Montana. Scale 1:24,000.

PHOTO ANALYSES

Exxon Corporation Oil Refinery Site

The Exxon Corporation Oil Refinery (Figures 2-4) is located in Billings, Montana, adjacent to the Yellowstone River. It encompasses approximately 144 hectares (355 acres). This site has been photo analyzed in an earlier report (AMD 83094-March 1984, p. 15). Little change is evident at the site, but descriptions of each feature follow with appropriate references to conditions present at the time of the earlier report.

The central portion of the refinery is, of course, the processing complex. To the north, south, and west of this complex are the storage tank farms. A large area of water treatment ponds, sludge landfilling, waste ponds, and spoil piles is visible adjacent to the Yellowstone River. Another large complex of water treatment ponds, sludge landfarming areas, and smoke scrubber waste piles are located east of the central processing area.

Surface drainage generally flows from the south to the north into the Yellowstone River. This drainage has been channelized at two locations; along the western edge of the site, and through the adjacent site, Montana Sulfur, and into an adjacent wetland on the eastern end of the facility.

Many stains and standing liquids within storage tank containments were observed. There was no significant change in these features since the earlier report. Area "A" in the southwestern portion of the site remains essentially unchanged with dark stains and stacked drums in evidence. Drums previously located south of Area "A" are no longer present at that location. It appears as though they have been moved to another drum storage location immediately to the north.

The portion of the site south of the Burlington Northern Railroad consists of an additional tank farm, a sludge landfarm area, and associated structures. Three changes have taken place since the earlier report. A small waste pond has been constructed at the south end of the tank farm. It is contained within previously existing revetments and holds a brownish liquid.

A possible discharge point and standing liquid nearby are located on the east side of the central processing complex (Figure 4). East of the central processing complex are two large piles of smoke scrubber waste, a large area of earthen spoil accumulations, and three parcels of land used for sludge farming. A dry creek flows from a feedlot south of the railroad, through another site, Montana Sulfur, through the smoke scrubber waste piles, appears to cross an irrigation canal, and flows east into a wetland.

North of the above mentioned waste piles is another large complex of water treatment ponds. One discharge into the Yellowstone River is present in this area. Gray-and-white toned spoil piles are seen near the water treatment ponds. No changes are evident in this area.

Northwest of the central processing complex (Figure 3) near the smaller complex of water treatment ponds, is an area that contains the intake and discharge points of the refinery's water treatment system. Two containment booms are in place on the discharge canal. Two spoil piles are present, one of which is revegetated. It appears as though oil sludge is being covered over with layers of earth. A large uncovered area of oil sludge is visible near the waste ponds.



Figure 3. Exxon Corporation Oil Refinery and Montana Sulfur Sites, August 27, 1983, western halves. Approximate scale 1:8,000.

INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- - - - - PROPERTY LINE
- + GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- - - - - DRAINAGE
- ← FLOW DIRECTION
- ↔ INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- - - - - POWERLINE

SITE FEATURES

- |||||| DIKE
- ~~~~~ STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- ⬭ EXCAVATION, PIT (EXTENSIVE)
- ⬭ MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

Montana Sulfur Site

This facility is located in Billings, Montana, adjacent to the Exxon Corporation Oil Refinery (Figure 2). Its approximate size is 6 hectares (15 acres). The facility has a long narrow appearance, being situated between the Burlington Northern Railroad and the Exxon refinery property boundary. One surface drainage flows through the site on its way to a wetland east of the Exxon facility. The east end on the Montana Sulfur facility is used for material storage; however, four stockpiles of sulfur are also located here. Runoff from these stockpiles could flow into a small drainageway to the south which, in turn, empties into the above mentioned drainage that flows north toward the wetland community. The next feature to the west is a small accumulation of drums located adjacent to a small waste pond. The pond has no observable breach or seepage points. West of the pond at Annotation "A," sulfur has been spread out on the ground surface. Immediately to the west is a soil disturbance. Perhaps the sulfur is in the process of being buried. Runoff from this area would flow into the small drainageway to the south. A small amount of apparent waste materials is located on the west bank of the north-flowing drainageway. West of this feature is the central processing area of the facility. A large vat containing sulfur, presumably associated with the industrial process, is visible. Some small amounts of sulfur are visible immediately north of this vat. Only one other feature was deemed significant at this facility. At the western end of the site (Figure 3), yellow liquid and stains appear to exit from a building. This area is level and runoff probably would not transport the material offsite.



Figure 4. Exxon Corporation Oil Refinery and Montana Sulfur sites, August 27, 1983, eastern halves. Approximate scale 1:8,000.

Transbas Incorporated Site

The Transbas Inc. site (Figures 2 and 5), is located in Billings, Montana, approximately 1.6 kilometers (1 mile) southwest of the Exxon Corporation Oil Refinery site. The site is situated on a level alluvial plain. One drainage canal exists immediately west of the facility. The canal flows north into the Yellowstone River. An earlier report (AMD 83094-March 1984-p. 23) presents an analysis of July 26, 1982 photos of this site. The facility itself consists of a central processing structure, three wash ponds, and a structure used for storage and shipping. The facility is approximately 3.5 hectares (8.6 acres) in size. Little change is evident since the analysis in the March 1984 report (photography date July 26, 1982); however, some differences do exist and will be discussed.

Waste Ponds 1 and 2 are unchanged. Waste Pond 3 now contains no liquid and it appears as though the lining has also been removed. Some dark stains are present within the pond.

Stains and soil disturbances are present to the east of ponds 1 and 2. In the earlier report, this area had stains and a small pit containing orange liquid.

Drums are located in two areas adjacent to the central processing complex structure. A third drum storage area is located west of the three waste ponds.

No change is noted in the vertical processing tank.

Some dark stains are observed on the concrete apron at the southeast corner of the property.

No other significant changes are observed.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- - - - - PROPERTY LINE
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- + SECTION CORNER

DRAINAGE

- ← - - - - DRAINAGE
- ← FLOW DIRECTION
- ↔ - - - - ↔ INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- - - - - POWERLINE

SITE FEATURES

- |||||| DIKE
- ~~~~~ STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- ~~~~~ EXCAVATION, PIT (EXTENSIVE)
- ~~~~~ MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

Figure 5. Transbas Incorporated site, August 27, 1983. Approximate scale 1:3,840.



Figure 6. Local site location, Somers, Montana. Scale 1:24,000.

Burlington Northern Tie Treating Site

The Burlington Northern Tie Treating site (Figure 6) is located on relatively level terrain on the north shore of Flathead Lake in Somers, Montana. The plant is approximately 23.5 hectares (58 acres) in size. The central tie treating facility is seen in the southeastern portion of the site. This central processing area is serviced by numerous railroad spurs that emanate from a main rail line to the northwest. Materials storage areas are located west, northwest, and north of the central treatment plant (Annotation "A").

The main processing area is located at annotation "A". Dark stains are at various locations near the processing area. Runoff from this area flows to the southeast into waste pit number 1 where it is contained. Waste pit 2 is seen immediately to the south. No apparent drainageway from the processing area can be seen, but the pit is darkly stained. A small area of sediment is located north of waste pit 2. This sediment may have resulted from past runoff from the processing area. Three uncontained tanks are visible north of the processing area; however no stains are associated with them and any spills would remain in the immediate vicinity. Area "B" is a materials storage area. The southeastern end is no longer in use and is becoming revegetated. The northwestern end is still in use. Some rill erosion is evident north of the facility; however it is probably related to extensive overgrazing in these areas.

An impoundment complex is located in the western portion of the facility. It consists of three impoundments, one of which is filled with liquid. The two unused impoundments are completely revegetated. No evidence of vegetation damage was observed.

Another materials storage area is present in the northwestern portion of the facility and south of that are three accumulations of debris, two of which have dark stains. Two areas of soil disturbance are visible nearby.



Figure 7. Burlington Northern Tie Treating Site, August 29, 1983.
Approximate scale 1:8,000.

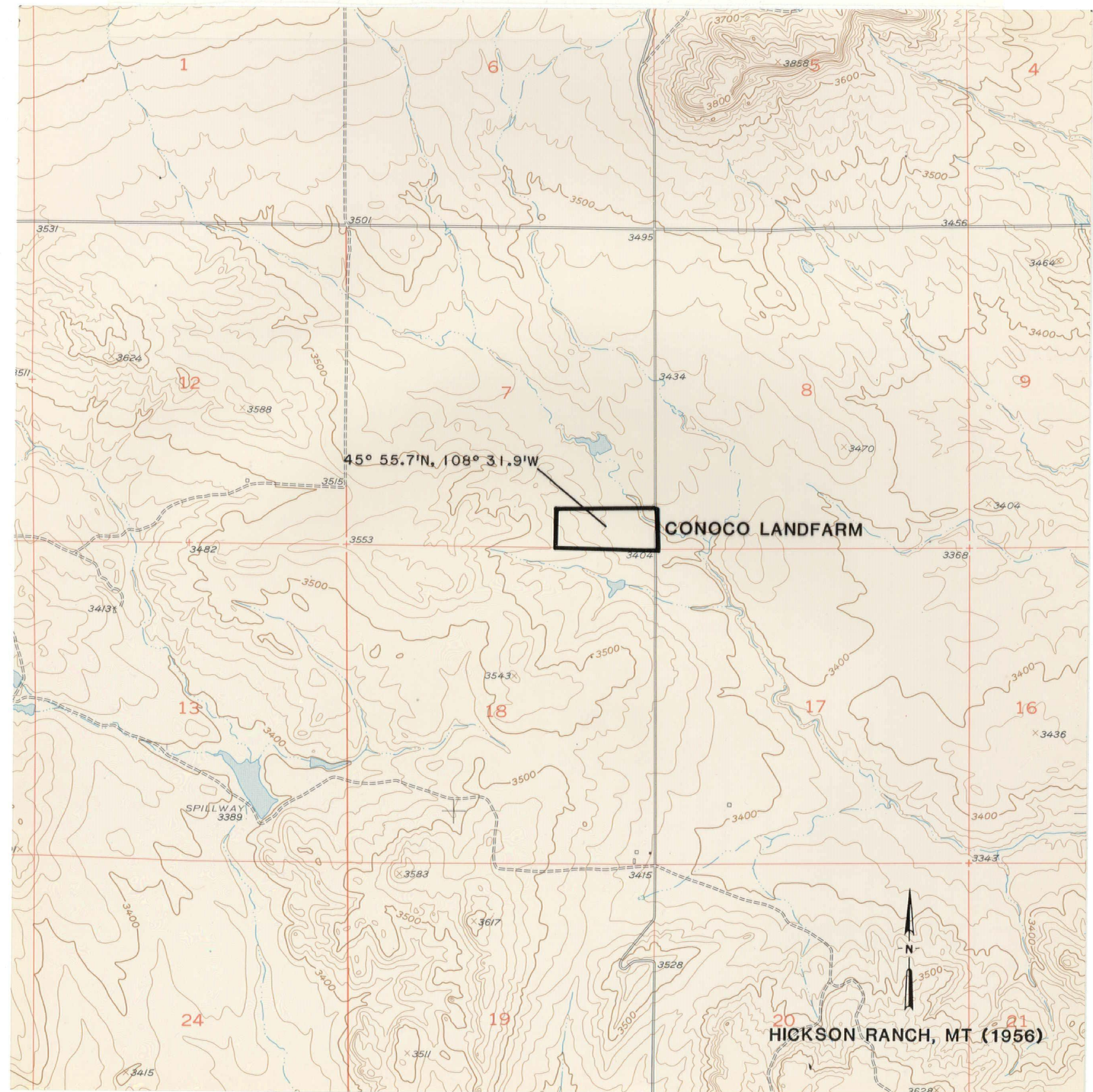


Figure 8. Local site location, Hickson Ranch, Montana. Scale 1:24,000.

Conoco Landfarm Site

The Conoco Landfarm Site (Figures 8 and 9) is located approximately 16 kilometers (10 miles) north of Billings, Montana. Surface drainage flows to the southeast. The site consists of seven small landfarm areas separated by a berm network. The areal extent of the total site is approximately 10.5 hectares (26 acres). Apparently, each of the small areas or "cells" is used for the spreading of sludge by-products. Five of the seven cells have dark stains within them. One cell had some sludge with its oily sheen visible on the surface. No breaches or seepage points were detected on the site's embankments. One small area of rill erosion was observed near an embankment. Two small dark stains are visible nearby.

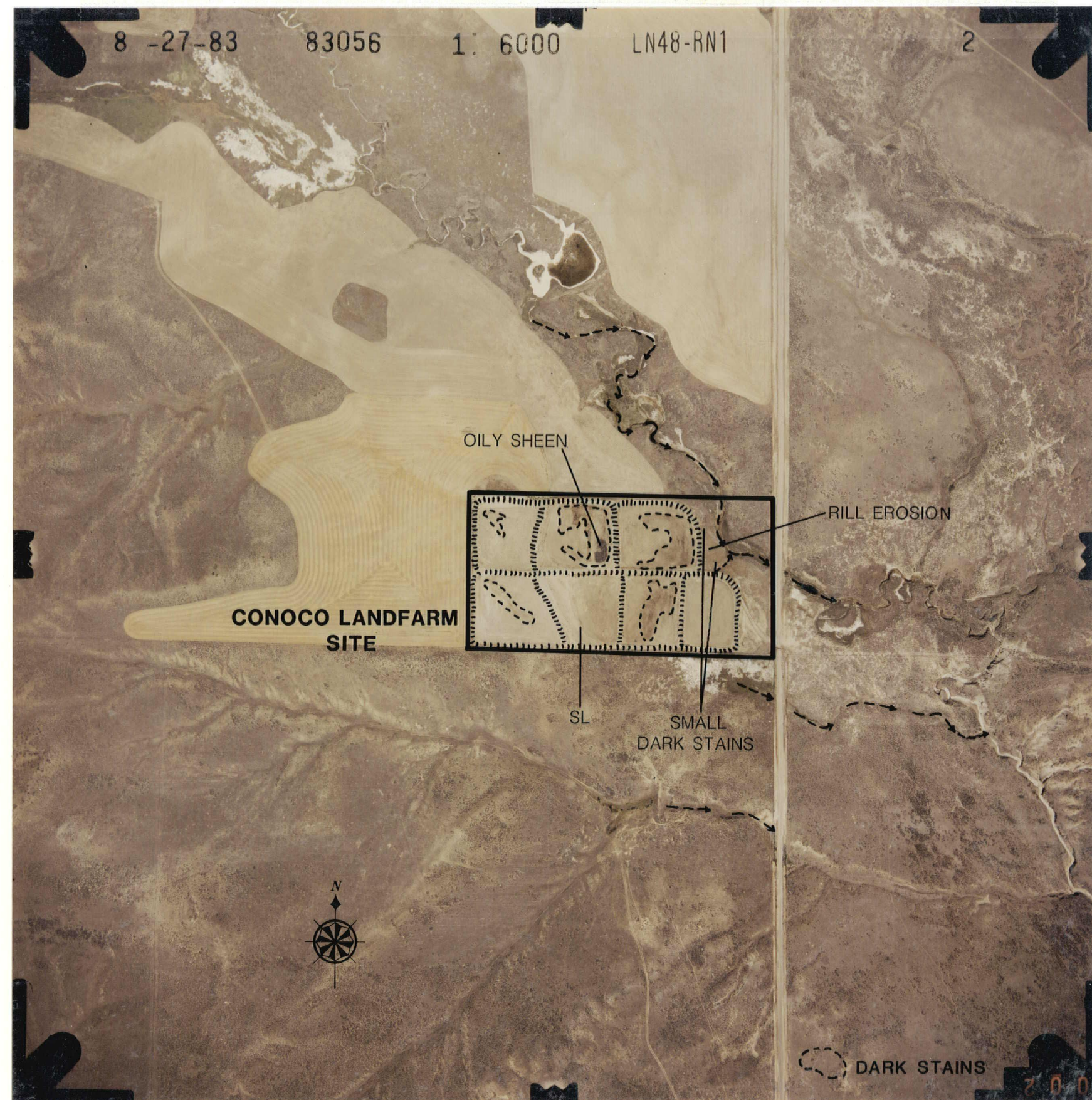


Figure 9. Conoco Landfarm site, August 27, 1983. Approximate scale 1:6,000.

INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- - - - - PROPERTY LINE
- GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- ← - - - - - DRAINAGE
- ← FLOW DIRECTION
- ↔ - - - - - INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- - - - - POWERLINE

SITE FEATURES

- ||||| DIKE
- ===== STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
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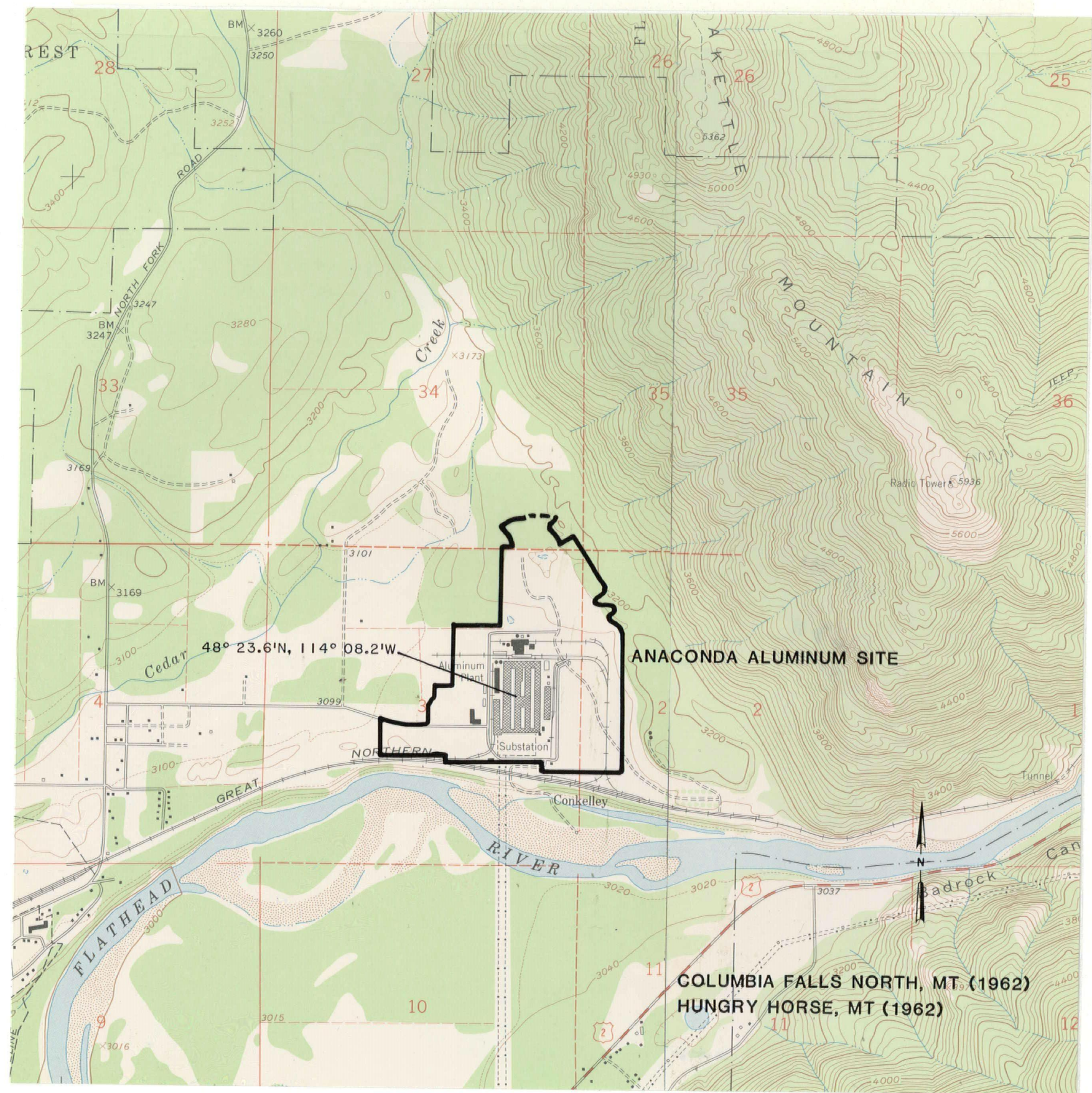


Figure 10. Local site location, Columbia Falls, Montana. Scale 1:24,000.

Anaconda Aluminum Site

The Anaconda Aluminum plant (Figures 10 and 11) is located approximately 3.6 kilometers (2.25 miles) northeast of Columbia Falls, Montana. The plant and its associated property is approximately 89 hectares (220 acres) in size and situated on relatively level terrain. The northern portion of the site is slightly higher in elevation than the southern portion so surface drainage tends to flow toward the Flathead River. The central processing facility, transformer yards, and administrative offices are visible in the central and southern parts of the site. No significant drainage was detected in this southern area.

Impoundment 1 apparently receives flow from the processing area. Additional discharge appears to be coming from the plant into the southwest corner of the impoundment. A thin film of unknown origin is present on top of the liquid surface at the eastern end of the impoundment. Drainage flows from Impoundment 1 into Impoundment 2 to the west.

North of the northeast corner of the main processing building is an area of pooled liquid. A drainage pathway proceeds to the northwest from that point. Evidently, the flow collects in a level area adjacent to a fence. To the east and north of this collection area are two accumulations of apparent industrial by-products. Liquid from one of these accumulations flows to the same above mentioned collection area. A large waste pond (Waste Pond 1) filled with grayish material can be seen nearby. The berm around this pond is secure with no leakage or seepage points detected.

East of Waste Pond 1 is an area containing two lined lagoons and three apparent mounds of waste. An underground pipeline leads from lined lagoon 2 to Waste Pond 1. A large accumulation of industrial by-products are present between the two lagoons. The by-products have a gray tone and are situated in a fenced area apparently dedicated to disposal of such waste. An access road can be seen leading up to this area. The other two waste accumulations are in the process of being revegetated. Another revegetated mound of apparent waste material is present immediately to the west of Lagoon 2. Northwest of Lagoon 2 is one more waste disposal location. Grayish debris and material have been deposited in a shallow pit. No runoff would be transported to adjacent areas. Some surface runoff from this area might reach the agricultural irrigation canal to the west.

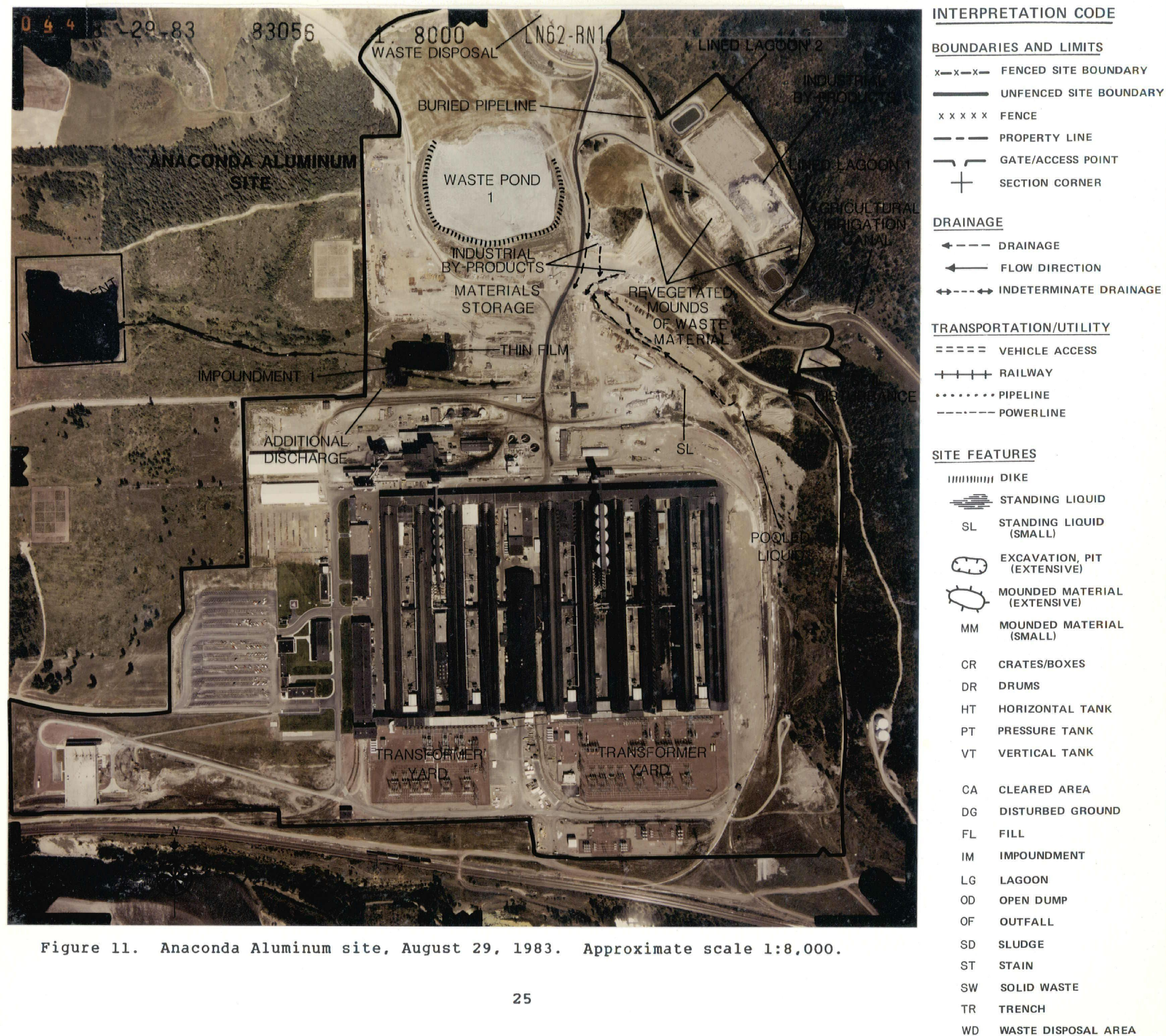


Figure 11. Anaconda Aluminum site, August 29, 1983. Approximate scale 1:8,000.

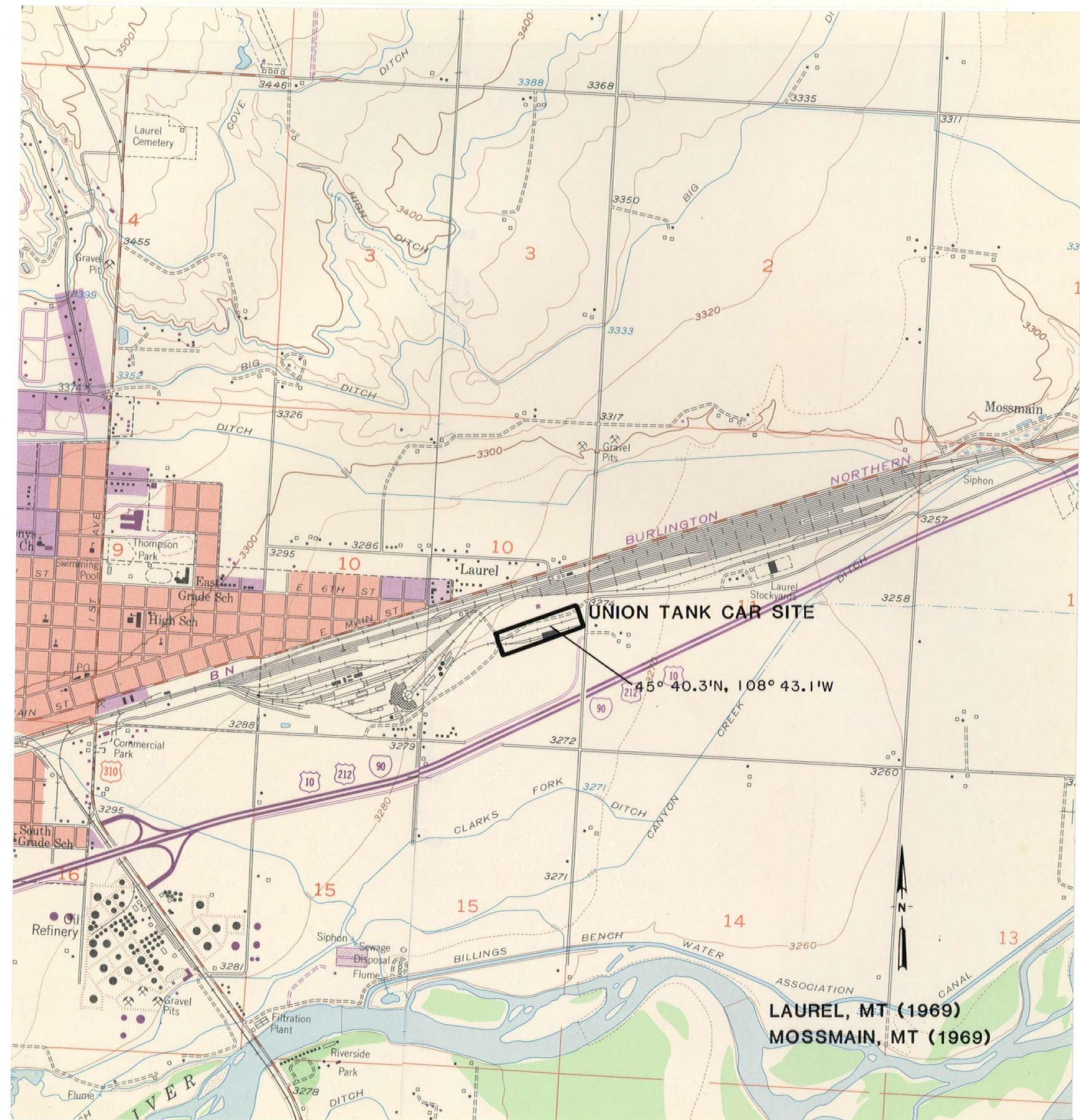


Figure 12. Local site location, Laurel, Montana. Scale 1:24,000.

Union Tank Car Site

The Union Tank Car site occupying 5.2 hectares (13 acres), is located on the southeast side of Laurel, Montana. The site appears to be a tank car cleaning or refurbishing facility. The site appeared to be inactive at the time of the 1983 photograph.

Spillage is visible at three points on the southwestern side of the site. Heavy staining is present in this area and at three other locations within the site. Two of these stains are associated with loading racks in the northeast corner of the site.

Two small deposits of a dark sludge-like material are located in the southwest corner of the site. The nature of these deposits is not apparent. An area of stressed vegetation is located on the southwestern edge of the site; however, it does not appear to be related to the deposits. Five horizontal storage tanks are present at the site and two tank cars are also present. An extensive depression and a small pit are located south of the site. Runoff from much of the site would collect in this depression. Drainage at the site is generally from north to south. A security fence surrounds the site at the time of the 1983 photograph. Soil within the site appears to have been contaminated; however, the site does not appear to have had a significant impact on the surrounding environment.



Figure 13. Union Tank Car site, August 27, 1983. Approximate scale 1:2,050.

INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x FENCED SITE BOUNDARY
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- OD OPEN DUMP
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- SD SLUDGE
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- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

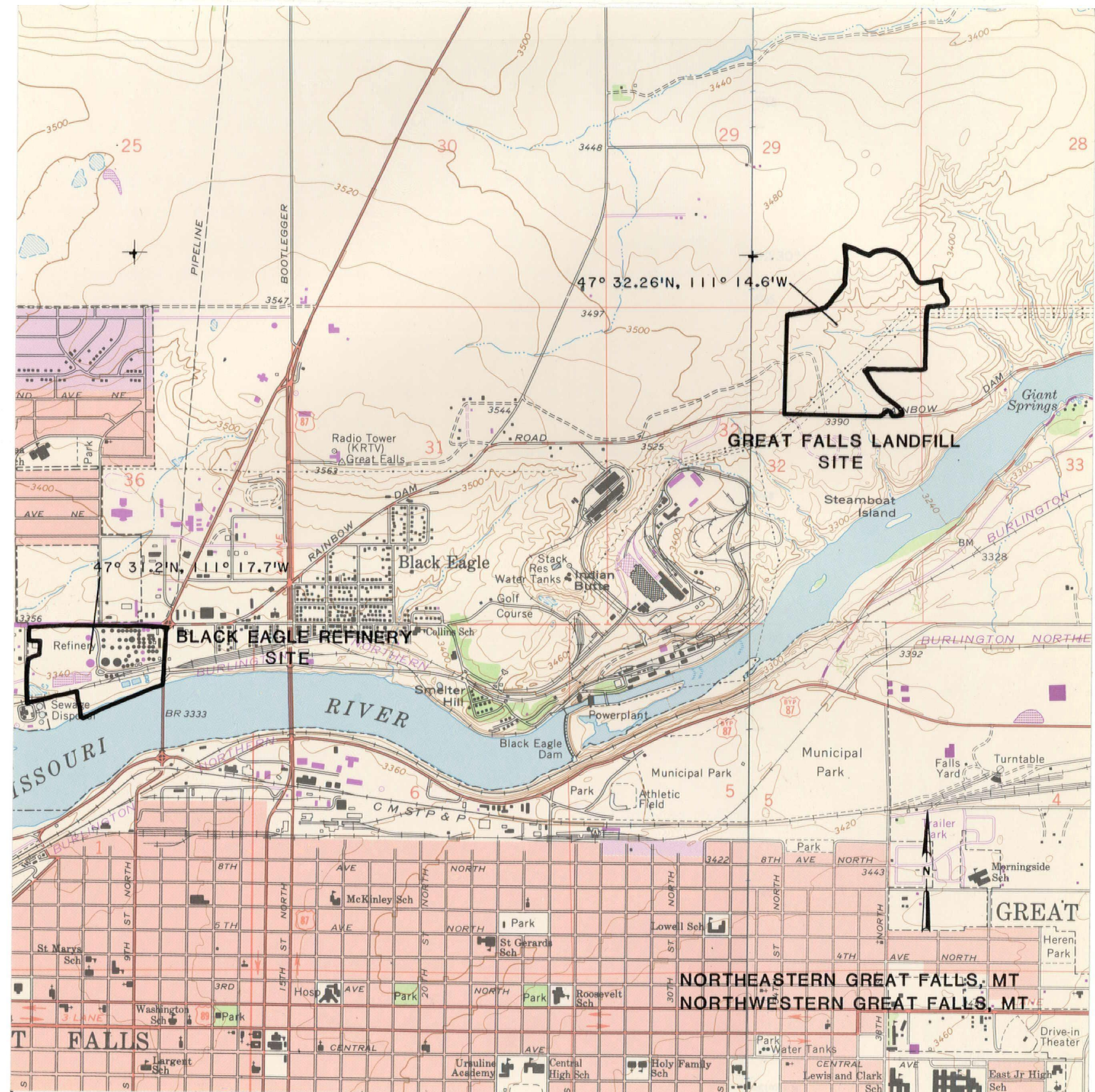


Figure 14. Local site locations, Great Falls, Montana. Scale 1:24,000.

Black Eagle Refinery

The Black Eagle Refinery, Figures 14 and 15, is located in Black Eagle, Montana, on the Missouri River. Its approximate size is 24.2 hectares (60 acres). Drainage is generally from the northeast to the southwest. The eastern one-half of the site is the refinery and tank storage area. Poor housekeeping is evident with dark stains scattered throughout this portion of the site. Several storage tank containments hold dark colored and brown liquids. Revetments around all tanks show no evidence of breach or seepage points. A possible leaking tank and pipeline are also present.

Two small accumulations of drums are visible in the northeast corner of the central processing area. On the western end of the storage tank complex is an accumulation of sludge-like material. Runoff from this accumulation would flow west and then south into a low topographic area at the southwest corner of the site. Two small accumulations of drums are visible near a materials storage area in the center of the site. One accumulation is located in the drainageway mentioned above.

West of the tank storage area is an old waste pond complex. Berms are visible at the perimeter of the ponds as well as an apparent elevated roadway. The complex is situated in a slight topographic depression. Six areas having dark stains are present.

At the extreme western end of the refinery is an apparent maintenance yard. Dark stains are visible on the paved surface. Runoff from this area would probably flow south onto a naturally vegetated surface. South of the maintenance yard is a small pond with an access road on the north side. The road appears to have been extended into the pond, perhaps some waste disposal is occurring at this location.

Next to the small pond is an oil reclamation unit. Two ponds are visible. No apparent problems were noted here. An accumulation of drums is present nearby. Drainage from this location flows to the low topographic area in the southwest corner of the site. Two areas of dark stains are visible to the east in the drainageway.

South of the Burlington Northern railroad another apparent oil reclamation unit consisting of two ponds, associated structures and equipment, and an oil sump is visible. Another oil sump is present immediately north of the railroad near the central processing area.



Figure 15. Black Eagle Refinery site, August 29, 1983. Approximate scale 1:8,000.

INTERPRETATION CODE

BOUNDARIES AND LIMITS

- X-X-X-X FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- X X X X X FENCE
- - - - - PROPERTY LINE
- GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- ← - - - - - DRAINAGE
- FLOW DIRECTION
- ↔ - - - - - INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- - - - - POWERLINE

SITE FEATURES

- |||||| DIKE
- ===== STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

GREAT FALLS LANDFILL SITE, ANALYSIS SUMMARY

The Great Falls Landfill site (Figures 15 and 16-20) occupied approximately 44 hectares (108 acres) at the time the 1983 photo was acquired. It is located north of the Missouri River approximately 3 kilometers (1.8 miles) east of Great Falls, Montana. Photographs acquired in 1950, 1964, 1966, 1977, and 1983 were used in the analysis of the site. The site lies on a bench overlooking the river. This bench is drained by several fairly deep ravines. Drainage at the site is generally to the south and east. Runoff from the site would reach the river approximately 202 meters (666 feet) away. Throughout the analysis period agricultural lands bordered the site on the north, east, and west.

Analysis of the photograph shows that waste disposal was first practiced at the site between 1950 and 1964. Extensive amounts of solid waste were seen deposited in ravines at the site in 1964. Solid waste disposal was evident at numerous other locations during the analysis period; however, the amount of waste observed appeared to decrease with time. A smoke plume was observed on the 1966 photograph suggesting the waste was being burned as part of the disposal process. Fill areas of varying size were observed at the site in 1966, 1977, and 1983. On the 1966 photograph standing liquid was visible on the fill surface, possibly the result of seepage from buried wastes. Solid waste apparently mixed in with the fill material on the 1983 photograph also suggests the presence of buried waste. Heavy staining, which appeared to be the result of liquid waste disposal was visible on the 1964 and 1966 photographs. Burial trenches and pits could be seen on the 1964, 1977 and 1983 photographs. On the 1977, and 1983 photos disposal of solid waste into trenches or pits was observed.

An extensive old waste disposal area was located in the northern section of the site in 1977 and 1983. This waste was apparently deposited between 1966 and 1977. In 1983 part of this area was covered by new fill material. Three barriers were built between 1977 and 1983 across a ravine running east from the site. Their purpose is probably to collect debris from the landfill. By 1983 fences had been completed around several sections of the site. Also in 1983 the western and southern sections of the site showed signs of revegetation; however, the areas remain heavily scarred.

August 27, 1950 Photograph

Figure 16 shows the location of the Great Falls Landfill site prior to any waste disposal activity. The outline depicted shows the site at its greatest areal extent which occurred in 1966 (Figure 18). The area is occupied by undeveloped steppe lands. Agricultural lands are located immediately north of the future site location. A significant drainage runs through the northern section of the site area. This drainage eventually reaches the Missouri River 0.6 kilometers (0.4 miles) south.

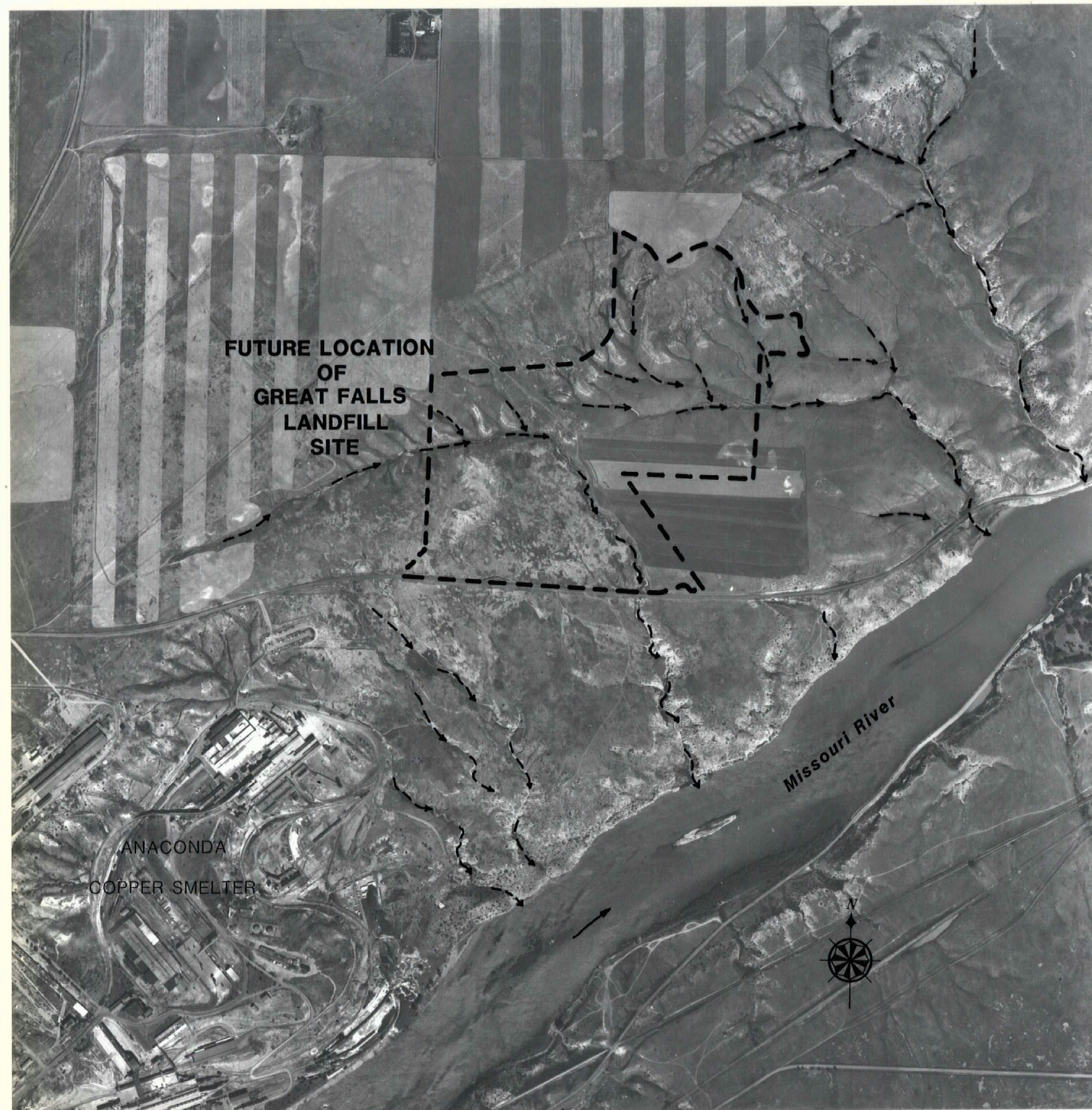


Figure 16. Great Falls Landfill site, August 27, 1950. Approximate scale 1:10,500.

INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x—x—x—x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- - - - - PROPERTY LINE
- ┌ ─ ─ ─ ┐ GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- ← - - - - - DRAINAGE
- ← FLOW DIRECTION
- ↔ - - - - - INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

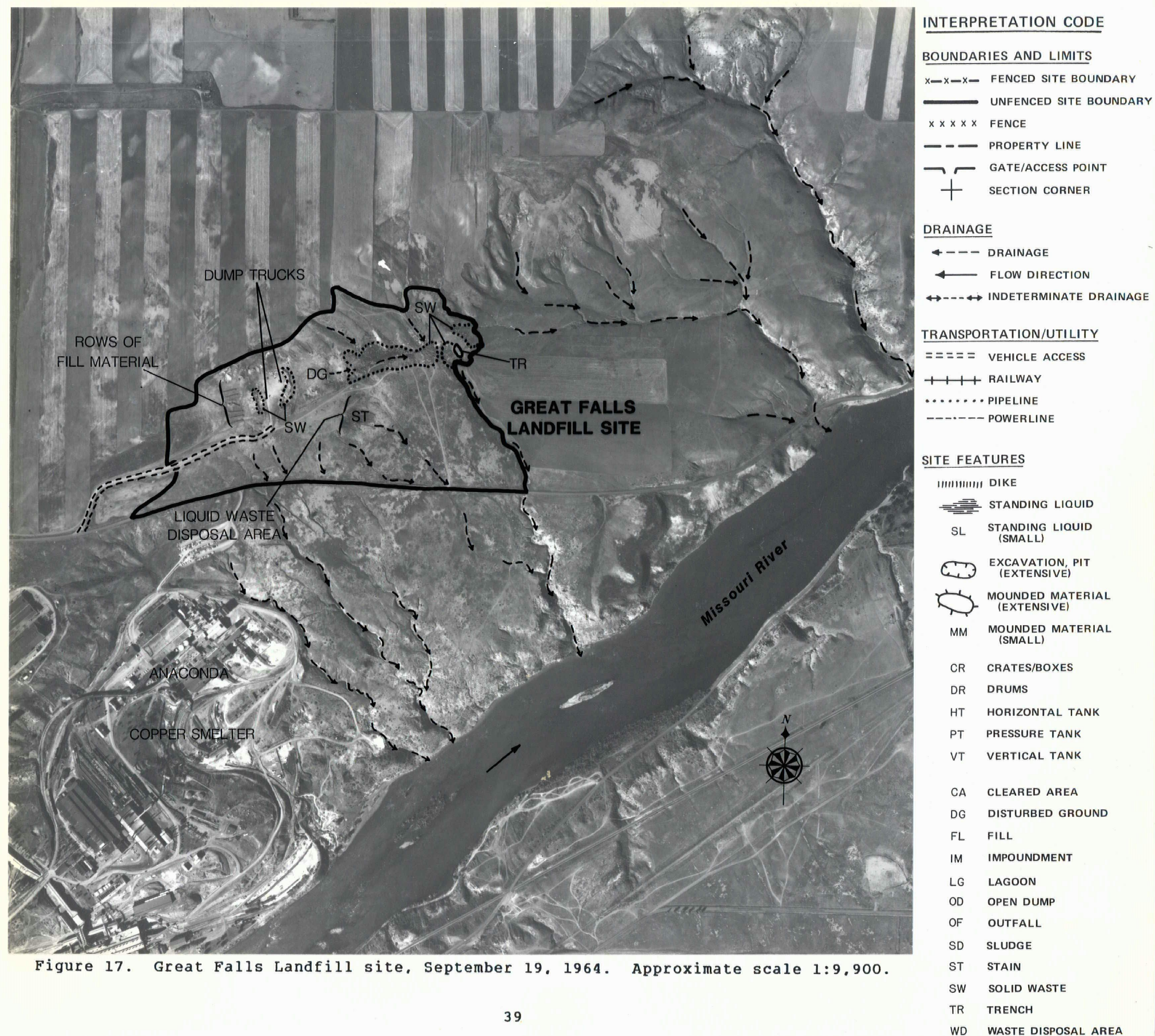
- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- - - - - POWERLINE

SITE FEATURES

- ||||||| DIKE
- ===== STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- ⬭ EXCAVATION, PIT (EXTENSIVE)
- ⬭ MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

September 19, 1964 Photograph

Figure 17 shows that waste disposal activity is underway at the site. Five extensive solid waste deposits are present in the northern section of the site. Most of the waste has been disposed of in the drainage running through the site. A new access road has been constructed into the site from the west. Dump trucks can be seen at several points within the site. Heavy staining is visible at a point near the center of the site. It appears that these stains are the result of liquid waste disposal in this area. Seven rows of fill material are present near the western edge of the site. The nature of this material is not apparent.



July 15, 1966 Photograph

The 1966 photograph (Figure 18) shows that a large fill area is now present at the site. A second smaller fill area is also located near the eastern edge of the site. Small pools of standing liquid are present on the surface of the larger fill area. These pools could be accumulated precipitation or seepage from buried wastes. Solid waste is being deposited at five points within the site. Two of these areas are located in drainages. A smoke plume visible at one of these areas indicates that waste is being burned at this point. Staining at the liquid disposal area is heavier than in 1964. Some of the liquid stains reach to the local drainage pattern; however, it does not appear that any of the liquid has left the site. Staining is also visible at two other locations within the site. One of these is at a solid waste disposal area. Debris can be seen scattered through a drainage east of the site, this is probably refuse blown off the site.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- - - - - PROPERTY LINE
- ┌ ┐ GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- ← - - - - - DRAINAGE
- ← FLOW DIRECTION
- ↔ - - - - - INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- - - - - POWERLINE

SITE FEATURES

- |||||| DIKE
- ===== STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- ⬭ EXCAVATION, PIT (EXTENSIVE)
- ⬭ MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

Figure 18. Great Falls Landfill site, July 15, 1966. Approximate scale 1:10,400.

October 15, 1977 Photograph

Significant changes have occurred at the site since 1966 as shown in Figure 19. The shape of the site has been altered. Part of the western sections of the site are now under cultivation. Waste disposal activity has also been extended to the east. Fences have been installed along four sections of the boundary. A fairly large solid waste deposit is visible near the center of the site. Several vehicles and dumping activity are associated with this deposit. The two burial pits also located in this area appear to be the remnants of a longer trench where waste has been deposited, filling in the center of the trench. A fill area is located immediately adjacent to the solid waste deposit. This could be an area where waste has been covered over. An extensive old waste disposal area occupies most of the northern section of the site. Two drainages run through this area which could carry contaminants off the site. Four small rectangular pits have been dug at the eastern edge of the site. These pits could have been dug for waste burial; however, no burial activity is evident at this time. In the southern section of the site two areas of disturbed ground are visible and earth has been bulldozed to form a rectangular dike. Small amounts of liquid are visible within this dike; however, it is not clear whether it is waste or accumulated precipitation.

August 29, 1983 Photograph

The 1983 color photograph (Figure 20) shows that the site has been expanded since 1977. Solid waste disposal is still underway at the site. Solid waste deposits are visible at three locations within the site. Bulldozers and several other vehicles indicating dumping activity can be seen at the primary area near the center of the site.

The fill area located immediately west of this point has expanded significantly since 1977. Solid waste scattered over this area suggest that waste is being buried here. Four pits visible in the northeast corner of the site in 1977 have been filled with solid waste. A small concentration of waste is also located west of the fill area. A small pit is located nearby. These features are located in the same area where dumping and burial trenches were observed in 1977. A white residue is also present in this area.

Six mounds of earth can be seen both west and south of the fill area. These are probably stock piles for waste burial. In the northern section of the site a new area of bulldozed ground is visible. No solid waste is visible at this area. Landfill surfaces in the southwest section of the site are beginning to show signs of revegetation (Annotation "A"); however, the vegetation appears stressed and ground scarring is still present throughout these areas. No vegetation is visible on the old waste disposal area. The three barriers running across the wash east of the site are probably there to prevent debris from flowing or blowing off the site. No waste disposal is evident in the large excavations in the southeast section of the site.



Figure 20. Great Falls Landfill site, August 29, 1983. Approximate scale 1:8,000.

INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- - - - - PROPERTY LINE
- - - - - GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- - - - - DRAINAGE
- FLOW DIRECTION
- INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- - - - - POWERLINE

SITE FEATURES

- ||||| DIKE
- STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

BILLINGS LANDFILL SITE, ANALYSIS SUMMARY

The Billings Landfill site occupied approximately 40 hectares (100 acres) at the time of the 1983 photograph; however at its greatest extent, which occurred in 1966, the site occupied a significantly greater area. The site is located approximately 4.7 kilometers (2.9 miles) south of Billings, Montana. Photographs acquired in 1957, 1966, 1972, 1979, and 1983 were used for the analysis.

The site lies on an upland overlooking the Yellowstone River. This upland is drained by small canyons, and terrain in the site area is fairly rugged. Drainage at the site is to the northeast with a small area of the site draining to the south. Runoff from the site would eventually reach a branch of the Yellowstone River. Most of the land immediately surrounding the site remained undeveloped throughout the analysis period.

Analysis of the photographs reveals that waste disposal was first practiced at the site between 1957 and 1966. Solid waste was deposited at eight locations in 1966; however, in 1972 and 1979 only one deposit was visible. In 1983 the amount of waste once again appeared to increase, reversing a downward trend. A large fill area was first observed in 1979. The size of this area was seen to increase in 1983. Partially buried solid waste visible on the fill surface indicates waste burial as the prime purpose of this feature. Unidentified liquid and extensive staining on this landfill on the 1983 photograph show that liquid waste disposal was also practiced. A radial pattern of trenches was observed on the east side of the site in 1966, 1972, 1979, and 1983. The nature of these trenches or the mounds associated with them was not apparent and waste disposal at the area could not be confirmed. Extensive areas of disturbed ground and ground scarring were observed throughout the site. These features were probably formed as a result of excavating for fill material. Smaller stains were also observed at the site in 1966 and 1979. Fences restricted vehicular access to portions of the site from 1966-1983; however, the majority of the site boundary remained unfenced throughout the analysis period. The 1983 photograph shows some revegetation of a section of the landfill surface (Annotation "A").

July 16, 1957 Photograph

Figure 22 shows the area later to be occupied by the Billings landfill. The area lies on semi-arid tableland south of the Yellowstone River. The area is dissected by deep ravines and gullys. A small canyon runs northeast through the site area. Drainage is generally to the northeast except for the southern edge of the site where runoff would enter either one of two other small canyons.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x—x—x—x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- PROPERTY LINE
- ┌┐ GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- ←--- DRAINAGE
- ← FLOW DIRECTION
- ↔---↔ INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + RAILWAY
- PIPELINE
- POWERLINE

SITE FEATURES

- |||||| DIKE
- ===== STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- ⬭ EXCAVATION, PIT (EXTENSIVE)
- ⬭ MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

Figure 22. Billings Landfill site, July 16, 1957. Approximate scale 1:12,000.

July 22, 1966 Photograph

The 1966 photograph (Figure 23) shows that extensive waste disposal activity is underway at the site. Actual dumping activity is visible on the west central edge of the site; solid waste is visible at this and seven other locations within the site. No attempt to cover the waste has been made and waste disposal appears to be taking place in a random manner. Staining is associated with one of these areas. All of the disposal areas are located in drainages and contaminants from the waste could be carried off the site by runoff. Five narrow shallow trenches are arranged in a radial pattern in the southeast section of the site. Four mounds appear to be associated with these trenches and the ground around the trenches appears to be charred or stained. The nature of these trenches is not apparent. New fences run across the entrance to the site on the north and along two other sections on the south and west. Large areas of disturbed ground can be seen throughout the site.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- - - - - PROPERTY LINE
- ┌ ─ ─ ─ ┐ GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- └ - - - - ┘ DRAINAGE
- └ ─ ─ ─ ┘ FLOW DIRECTION
- └ - - - - ┘ INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- - - - - POWERLINE

SITE FEATURES

- |||||| DIKE
- ~~~~~ STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- ⬭ EXCAVATION, PIT (EXTENSIVE)
- ⬭ MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

Figure 23. Billings Landfill site, July 22, 1966. Approximate scale 1:12,000.

July 24, 1972 Photograph

Figure 24 shows that waste disposal activity at the site appears to have decreased since 1966. Solid waste is only visible in one location. A canyon previously included in the northeast corner of the site where solid waste was observed in 1966 shows no sign of waste disposal activity or solid waste. Traces of the radial trench pattern visible in 1966 are still present, along with the mounds. No activity is evident at this location. Extensive areas of disturbed ground are still evident throughout the site. Two fences visible in 1966 are no longer present.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x—x—x—x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- PROPERTY LINE
- ┐— GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- DRAINAGE
- FLOW DIRECTION
- INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- POWERLINE

SITE FEATURES

- |||||| DIKE
- ===== STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

Figure 24. Billings Landfill site, July 24, 1972. Approximate scale 1:10,900.

September 14, 1979 Photograph

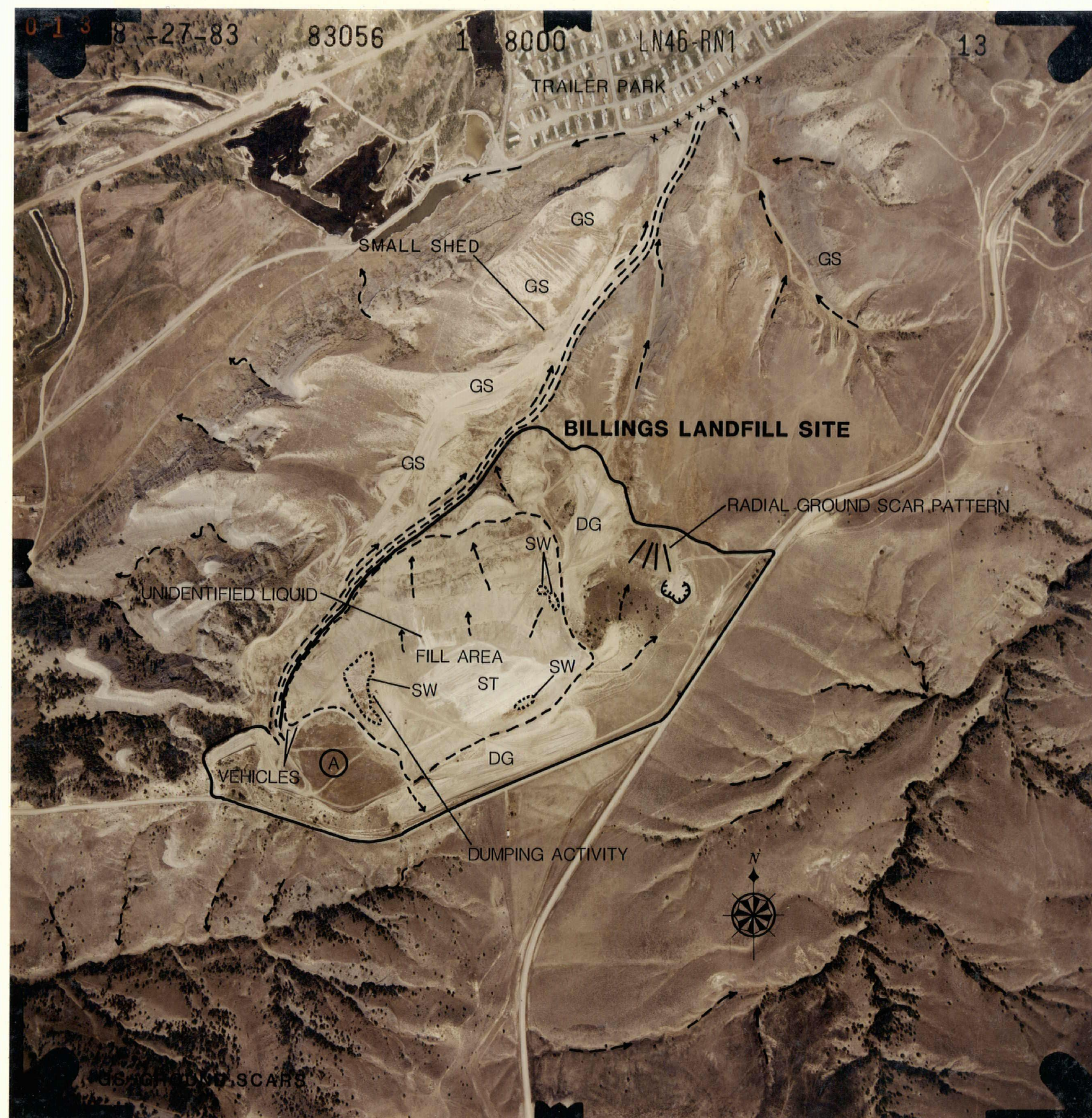
Figure 25 shows that significant changes have occurred at the site since 1972. Solid waste disposal can still be observed in an area north of where it was observed in 1972. An extensive fill area now occupies a large portion of the site. The place where waste disposal was observed in 1972 has now been covered by this fill material; solid waste seems to be intermixed with this material as a result of burial activity. Two large concentrations of spoil or fill material are present on the landfill surface. The disturbed ground and ground scarring observed along the walls of the canyon are probably the result of obtaining the fill material for use in waste burial. Four new small trenches have been dug in a new radial pattern on the east side of the site. An area of disturbed ground is also located nearby. No waste disposal is visible in this area. A small white-toned stain can be seen in the northern part of the site. The nature of the stain is not apparent.



Figure 25. Billings Landfill site, September 14, 1979. Approximate scale 1:12,000.

August 27, 1983 Photograph

The color photograph (Figure 26) shows that the landfill area has increased in size since 1979. A large amount of solid waste is visible where dumping activity is currently underway. A bulldozer and other earthmoving vehicles are present. Solid waste is also visible in smaller concentrations at two other locations. An unidentified white liquid can be seen flowing down the outboard face of the landfill. An extensive white stain is also visible on the top of the fill. The white liquid has its origin at the top of the landfill and appears to be the result of liquid waste disposal rather than leaching, as does the white stain. A new radial ground scar pattern can be seen where trenches have previously been located. A small excavation is now associated with this pattern. No waste disposal activity is present in this area. Two new areas of disturbed ground are present at the site. No solid waste is visible at the southern area; however, solid waste appears throughout the northern area where burial may have taken place. In the southwest corner of the site a section of the landfill surface has been revegetated (Annotation "A"); however, this vegetation appears to be dead or dormant.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- - - - - PROPERTY LINE
- GATE/ACCESS POINT
- + SECTION CORNER

DRAINAGE

- - - - - DRAINAGE
- FLOW DIRECTION
- INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + + RAILWAY
- PIPELINE
- - - - - POWERLINE

SITE FEATURES

- ||||| DIKE
- STANDING LIQUID
- SL STANDING LIQUID (SMALL)
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OD OPEN DUMP
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- WD WASTE DISPOSAL AREA

Figure 26. Billings Landfill site, August 27, 1983. Approximate scale 1:8,000.